REMARKS/ARGUMENTS

I. Claim Rejection – Provisional Double Patenting

The Examiner provisionally rejected pending Claims 1-3 under the doctrine of obviousness-type double patenting of the claims, over Claims 1-4 in Applicant's co-pending Application No. 11/320,873 in view of Utsumi et al. (US Patent No. 5,766,783) and Japanese Patent No. 404092865A. The Examiner states that although the conflicting claims are not identical, he believes that they are not patentably distinct from each other because the subject claims are encompassed by the claims of the co-pending application.

Accordingly, Applicant has submitted along with this Amendment and Response a proper and timely Terminal Disclaimer in order to overcome the rejection. As stated in the Terminal Disclaimer, Applicant currently owns both the present application and the other design patent application, thereby establishing common ownership. Applicant respectfully requests the reconsideration and withdrawal of this rejection.

II. Rejections Under 35 U.S.C. § 102

Claim 1 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Tanaka et al. (US Patent No. 6,001,748). Claim 2 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Tanaka et al. with support from Utsumi et al. (US Patent No. 5,766,783). Claim 3 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Tanaka et al. with support from Japanese Patent No. 404092865A (JP '865).

Claim 1 also stands rejected under 35 U.S.C. § 102(b) as being anticipated by Aida et al. (US Patent No. 5,668,524). Claim 2 stands rejected under 35 U.S.C. § 102(b) as being anticipated by Aida et al. with support from Utsumi et al. (US Patent No. 5,766,783). Claims 2-3

stands rejected under 35 U.S.C. § 102(b) as being anticipated by Aida et al. with support from Japanese Patent No. 404092865A (JP '865). Applicant respectfully traverses these bases for rejections.

In respectfully requesting reconsideration of this application, Applicant has canceled pending Claims 1-3 and added new claims 26-45 which Applicant believes more specifically point out and distinctly claim the present invention. No new matter has been added and the new claims have been added for the reasons specified below. Applicant believes that the following remarks address and overcome all of the Examiner's rejections.

I. The examiner pointed out that aluminum, gallium and indium crystal nitride layers are formed on the surface of a substrate composed of a sintered product of aluminum nitride, in US Patent No. 6,001,748 (column 6, lines 32-65; claims 6 and 19).

However, US Patent No.6,001,748 (Tanaka et al) is originally related with a large-sized nitride single-crystal, and indicates that the small-sized single-crystal (that is, it is considered that it is the single-crystal having the shape of a thin film) is not good for using as a functional material.

In the above-mentioned patent, a single-crystal will be grown so that it may become large-sized, and it is going to be used itself.

In US Patent No.6,001,748, the following is described; [The larger the size of the crystal, the smaller the disorder of the orientation of the crystal axis. This makes it possible to provide a functional material which best utilizes the orientation inherent in the crystal and possesses excellent practical properties. When the size of the single crystal is small, these merits cannot be obtained] (column 6 lines 1-6);

That is, the larger the size of crystal, the better the characteristics. And a small-sized single-crystal is bad contrarily.

The embodiment described above is shown in Example 7 (column 16, lines 33-36) and 8 (column 17, lines 17-19), wherein respectively a rod-like mass (that is a large-sized crystal) is grown, as the aluminum nitride single-crystal, on the substrate composed of a sintered product of aluminum nitride; and these are not a thin film being small-sized.

Even if there is a publication, wherein "a substrate composed of a sintered product of aluminum nitride" is used as indicated in (column 6, lines 32-65; claims 6 and 19), the substrate is only a substrate for growing a large-sized single-crystal, and there is no idea to try to acquire a special effect newly, combining a substrate and a crystal specially.

Moreover, as for the process of the crystal growth, it is the method of sublimating materials at high temperature in order to obtain a large-sized crystal. That is, AlN powder is sublimated at high temperature, such as 1850°C and 1900°C, as indicated in Example 7 and 8, and the massive single-crystals are produced.

In US Patent No. 6,001,748, the following is described; [Therefore, the substrate for growing the single crystal of a nitride may be any one so far as the material constituting the substrate can withstand the decomposition and vaporization temperature.] (column 9 lines 24-27). This means that it is required that only heat resistance should be high, as a substrate used for growth of a single-crystal.

The features of the present invention

On the other hand, contrary to US Patent No.6,001,748, this invention is based on an idea that a thin film-like single-crystal that is a small-sized single-crystal (US Patent No.6,001,748 describes that it is bad) will be used.

Furthermore, it is important that the above single-crystal thin film of small size may be formed on a sintered compact closely, and this invention was attained by the knowledge in which the

sintered compact having such a possibility can manufacture as a substrate.

This invention is based on an idea in which a single-crystal of the shape of a thin film, or a thin film having at least a single-crystal thin film layer may try to be formed in a good state without exfoliation, etc. on the substrate comprising a sintered compact, such as a ceramic-based sintered compact, having a heterogeneous microstructure, and it is going to try to use it for electronic devices, etc. in the state where the thin film is formed on the sintered compact closely. [there described in page 37 lines 8-11 of the specification of this invention that the substrate for a thin film comprises a sintered compact with the random crystal direction of a composition particle.]

In US Patent No. 6,001,748, as mentioned above, only enlargement of crystal size is asked for improvement in the characteristic, the substrate is required only for growing a large-sized crystal, and only heat resistance is called for.

Since it will be rather surmised that the substrate and the crystal are separated and only a crystal is used itself, if it is the mode of a case of Example 7 and 8 of US Patent No. 6,001,748, it is contrary to this invention.

On the other hand, this invention aims at improvement in the characteristic by close formation of the single-crystal thin film to a sintered compact, using a single-crystal thin film (that is a small-sized crystal in which US Patent No. 6,001,748 describes that it is bad).

In this invention, a substrate comprising a sintered compact having good surface smooth nature is offered in order to form a single-crystal thin film on the substrate closely.

Even if there is a case where the crystallinity of the thin film that is a small-sized crystal is not necessarily superior compared with a large-sized crystal, characteristics in which the III-V group nitride originally has may newly emerge by forming on such a sintered compact closely.

As mentioned above, this invention relates to a substrate for a small-sized single-crystal

(that is, a thin film), not for a large-sized (or massive) single-crystal, and it differs from US Patent No. 6,001,748 in that point.

That is, this invention is based on the knowledge in which it is important to use the sintered compact having average surface roughness not more than 2000 nm when a single-crystal of the shape of a thin film, or a thin film having at least a single-crystal thin film layer is formed on a sintered compact, such as a ceramic-based sintered compact. (page 151 lines 9-14; page 518 lines 8-18, and page 521 lines 5-16: Example 8, etc., in the specification of this invention)

If the sintered compact having such surface state is used as a substrate, the following results, etc. may be brought;

1) A thin film is formed on the sintered compact closely in the state having few exfoliations between the thin film and the sintered compact, and having few cracks of the thin film itself, etc., (page 50 line 27- page 51 line 5, and page 526 lines 2-7; Example 9, etc., in the specification of this invention)

2) The junction nature between the thin film and the sintered compact is also high, and the junction strength not less than 2 kg/mm^2 is easy to be obtained, (page 51 lines 11-16, and page 526 lines 15-19; Example 9, etc., in the specification of this invention)

3) The thin film formed has comparatively good crystallinity, such as the half width of a rocking curve not more than 3600 seconds, (page 151 lines 23-28, and page 518 line 26-page 519 line 3; Example 8, etc., in the specification of this invention)

4) The average surface roughness of the thin film formed is equivalent to the average surface roughness of a sintered compact, or it is easy to improve more than it, (page 155 line 26-page 156 line 12, etc., in the specification of this invention)

5) Even if a sintered compact has conduction via, metal, or an alloy, etc., a nitride thin film may be formed on the sintered compact closely, and may have good crystallinity. (page 184 lines

3-20, page 192 lines 17-27, and page 196 lines 6-12, etc., in the specification of this invention)

Moreover, in this invention, when a single crystal thin film is formed on the sintered compact having average surface roughness not more than 2000 nm, for example, the method for forming a thin film, such as a CVD method, an MBE method and a sputtering method, etc. using a gas containing nitrogen, is used, instead of the method of producing a large-sized crystal at high temperature, such as 1850°C or more, like the sublimating method. In this invention, it is sufficient that the temperature at the time of film forming is 1500°C or lower, a thin film is formed on a sintered compact closely, and the thin film having good crystallinity is obtained. (page 44 line 22-page 45 line 14, and page 45 lines 25-29, etc., in the specification of this invention)

Thus, also in a process, this invention differs from US Patent No.6,001,748.

The features of US Patent No.6,001,748 in comparison with this invention is summarized as follows;

a) US Patent No.6,001,748;

The functional material good in the practical properties is obtained growing a nitride into the large-size single-crystal, it is described that the single crystal with small size is not good

It is not going to obtain the above-mentioned functional materials combining a large-sized nitride single-crystal and a large-sized substrate, but is going to use the large-sized single crystal itself.

The substrate is only used in order to grow a large-sized nitride single-crystal at high temperature of 1850°C or higher, and only heat resistance is required as a substrate.

b) This invention;

Contrarily, using a thin film with small size, it is going to obtain the functional device good in the characteristics by forming the thin film on a sintered compact closely, and combining both.

Since film formation is usually carried out at the temperature of not more than 1500, heat resistance may be lower than the substrate of US Patent No.6,001,748.

Rather, the substrate good in the surface state is required as a substrate of this invention in order to use combining a single-crystal thin film and the substrate, a sintered compact having average surface roughness not more than 2000 nm is used.

As mentioned above, this invention relates to a substrate for a thin film of single-crystal, and it obviously differs from the substrate used for growing a large-sized single-crystal in US Patent No. 6,001,748.

The above knowledge is indicated in the specification at the time of the application of this invention, and is not the additions of a new matter.

The page and line indicated in this argument correspond to the specification at the time of the application [Attorney Docket No.:Y04S022, Application Date (national phase to USA); December 3, 2004].

II. As for a sintered product of aluminum nitride, a sintered compact having a hexagonal symmetry, and a sintered compact having optical permeability, the examiner pointed out that these are used as a substrate for thin film formation in US Patent No. 6,001,748, US Patent No. 5,766,783 (Utsumi et al), and Japanese Patent No. 404092865A.

However, although each above-mentioned sintered compact is the substrate material having the desirable characteristic for a thin film, it is one in the sintered compact comprising a ceramic material as a main component, and the claims about each above-mentioned sintered compact were deleted in this amendment.

Therefore, it seems that the matter pointed out by the examiner using US Patent No. 6,001,748, US Patent No. 5,766,783, and Japanese Patent No. 404092865A have been distinguished

from the present invention by this amendment.

III. The examiner pointed out that a substrate for thin film formation is indicated in US Patent No. 5,668,524(Aida et al.) (Example 1: column 12, lines 9-10).

However, the above substrate is different from the substrate of this invention in the following points;

a) It is considered that the AlN film formed in US Patent No. 5,668,524 (Example 1: column 12, lines 9-10) is not a single-crystal but a polycrystal having multiple X-ray diffraction peaks, such as (100), (002), (101), (102), (110), (103), (112) and (004). And, it is surmised that the AlN film is polycrystal, also from the description in which the angle obtained is plural. (column 12 lines 18-21)

If the AlN film is a single-crystal, only the peak diffracted from the specific lattice plane is detected. On the other hand, if the peak diffracted from the plural lattice plane of different direction is detected, the AlN film should be a polycrystal.

b) It is considered that the AlN film is a large-sized nitride crystal like US Patent No.6,001,748 because it has comparatively thick thickness as a film, so it is surmised that the film may not be called a film, rather, it should be called a plate. (column 12 lines 17-18)

c) The AlN film (plate) is used as a resistor by improving only the AlN film (plate) itself by controlling the amount of oxygen, the improvement is not based on the offer of a suitable substrate for the AlN film (plate). (Table 2)

Contrarily, in this invention, combining a substrate and a thin film of single-crystal is important, a suitable substrate should be provided in order to form a thin film of single-crystal on it closely.

d) It indicates that the surface of the AlN film (plate) is too coarse even when polishing was carried out, that is, another AlN film (plate) formed as a resistor by the same formation method in

Example 1 has large surface coarseness Ra of 0.02 mm after polish. (column 12 lines 30-32)

On the other hand, when using a substrate of this invention comprising a sintered compact having average surface roughness not more than 2000 nm, a thin film of single-crystal having high surface smooth nature, that is the average surface roughness not more than 2000 nm, may be provided on it, even if polishing of the thin film is not carried out.

Therefore, even if the substrate composed of a sintered product of aluminum nitride is used as indicated in US Patent No. 5,668,524 (Example 1: column 12, lines 9-10), the substrate is obviously different from the substrate for a thin film of single-crystal indicated in this invention.

And, claims about the sintered compact comprising aluminum nitride as a main component, the sintered compact having a hexagonal structure, and the sintered compact having optical permeability, were deleted.

Therefore, it seems that the matter pointed out from the examiner using US Patent No. 5,668,524, US Patent No. 5,766,783, and Japanese Patent No. 404092865A have been distinguished from the present invention by this amendment.

IV. Explanation of the claims after the amendment:

Hereafter, the reason of amendment is explained in each claim, except the explanation mentioned in the above argument.

In the explanation of each claim, the page and line of a specification in which the contents were described were shown.

The page and line of the specification used in the explanation correspond to those at the time of the application (Attorney Docket No.:Y04S022).

(Claims 1-4)

The reason is already explained in the above-mentioned argument.

(Claim 5)

The half width of a rocking curve is measured by 2θ/θ scanning or ω scanning. (2θ/θ scanning; page 223 lines 2-11, ω scanning; page 25 lines 26-28, etc., in the specification of this invention).

(Claim 6)

The reason is already explained in the above-mentioned argument.

(Claim 7)

The reason is already explained in the above-mentioned argument.

(Claim 8)

If the average surface roughness of a sintered compact is not more than 100 nm, on it, a single-crystal thin film having superior crystallinity can be formed. (page 152 lines 10-20, etc., in the specification of this invention)

(Claims 9-10)

A thin film conductive material comprising as a main component metal, an alloy, metal nitride, metal carbide and metal silicide, etc. may be formed on the sintered compact, on it, a thin film comprising as a main component gallium nitride, indium nitride and aluminum nitride may be formed generating few exfoliations and few cracks of the thin film itself, and each other junction nature is also high. (page 192 lines 22-27, page196 line 20-page 197 line 1, page 208

lines 14-20; and page 558 line 25-page 559 line 18: Example 18, in the specification of this invention)

Furthermore, the above-mentioned thin film conductive material may be formed on the surface and/or in the inside, to the thin film comprising as a main component gallium nitride, indium nitride and aluminum nitride. (page 202 lines 2-18, in the specification of this invention)

(Claim 11)

A conduction via comprising as a main component metal, an alloy and a metal compound having conductivity may be formed on the sintered compact, on it, a thin film comprising as a main component gallium nitride, indium nitride and aluminum nitride may be formed in the state having high junction nature, and the thin film formed has good crystallinity.

As for the specific resistance of a conduction via material, it is desirable that it is not more than $1x10^{-3}\ \Omega\cdot cm$ at room temperature.

(page 175 lines 20-27, page 176 lines 12-18, page 184 lines 3-20, page 188 lines 1-8, page 413 line 28-page 414 line 2; and page 509 lines 23-29: Example 3, in the specification of this invention)

(Claim 12)

A sintered compact having conductivity can be used as a substrate for thin film. As for the specific resistance of a sintered compact, it is desirable that it is not more than $1x10^{2}\ \Omega\cdot cm$ at room temperature. (page 34 lines8-9 and page 478 lines19-24; the mark 130 of Fig. 50, and page326 line23-page 327 line 1)

(Claim 13)

In the sintered compact having a thin film comprising as a main component gallium nitride, indium nitride and aluminum nitride, the surface roughness tends to be improved.

As a thin film formed beforehand on a sintered compact, a single-crystal thin film, an amorphous thin film, a polycrystalline thin film and an orientated polycrystalline thin film may be used.

(page 159 line 17-page 160 line 1, and page 169 line 27-page 170 line 18, in the specification of this invention)

Moreover, if using a sintered compact on which a thin film comprising as a main component gallium nitride, indium nitride and aluminum nitride is formed beforehand, a single-crystal thin film having better crystallinity may be formed on it.

(page 78 lines 5-24, page 597 lines 14-20: Example 25, in the specification of this invention)

(Claim 14)

The reason is already explained in the above-mentioned argument.

(Claim 15)

Using an abrasive and/or chemical agent, the surface of the sintered compact is processed, and heat-treating is carried out suitably after processing. (page 153 line 15-page 154 line 4, page 155 lines 6-15, and page 515 line 16-page 516 line 10; Example 8, etc., in the specification of this invention).

(Claims 16-17)

The reason is already explained in the above-mentioned argument.

(Claim 18)

It is shown that the content of nitrogen component in a gas containing nitrogen component and/or argon and being used at the time of film forming is 2-100 mol %. (page 581 lines 18-19: Example 22, and page 594 lines 12-13: Example 25, in the specification of this invention)

(Claim 19)

The example of the process used for thin film production is shown. (page 43 lines 12-20, in the specification of this invention)

(Claim 20)

The reason is already explained in the above-mentioned argument.

For all of the reasons explained above, Applicant believes that Claims 26-45 patentably distinguish in a 35 U.S.C. § 102 sense over Examiner's suggested references, and withdrawal of the above-described rejections are respectfully requested.

III. Conclusion

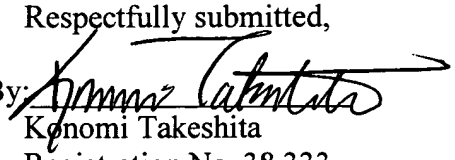
Having fully addressed al of the Examiner's rejections, Applicant submits that the reasons for the Examiner's rejections have been overcome. Applicant respectfully requests that a Notice of Allowance be issued. Should there by any questions or other matters of which resolution may be advanced by a telephone call, the Examiner is cordially invited to contact the

Applicant's undersigned attorney at the number listed below. All correspondence should be directed to our below listed address.

IV. Fees

A fee of $65.00 (for a Small Entity) for the Terminal Disclaimer pursuant to 37 CFR 1.20(d) is enclosed herewith. The Commissioner is hereby authorized to charge any other fees which may be required or credit any overpayment to **Deposit Account No. 502270**.

Respectfully submitted,

By: 

Konomi Takeshita
Registration No. 38,333
Omori & Yaguchi USA, LLC
Agent for Applicant
Eight Penn Center, Suite 1901
1628 John F. Kennedy Blvd.
Philadelphia, PA 19103
Phone No. (215) 701-6349